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21005 7590 06/17/2004	EXAMINER
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Please find below and/or attached an Office communication concerning this application or proceeding.

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>24 March 2004</u>.

2a)☐ This action is **FINAL.**   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18 and 20-136* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18 and 20-136* is/are rejected.

7)☐ Claim(s) *4 and 5* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
    Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1.   A request for continued examination under 37 CFR 1.114, including the fee set

forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this

application is eligible for continued examination under 37 CFR 1.114, and the fee set

forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action

has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on

3/26/2004 has been entered.

Claim Objections

2.   **Claim 4** is objected to because it does not match the original claim as filed. The

phrase "from said candidate index solution without degrading performance of the

workload and" at line 5 of the claim should be deleted.

3.   **Claim 5** is objected to because of the following informality: claim 5 depends

upon a subsequent claim (claim 56). Appropriate correction is required.

Claim Rejections - 35 USC § 102

4.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by
> another filed in the United States before the invention by the applicant for patent or (2) a patent
> granted on an application for patent by another filed in the United States before the invention by the
> applicant for patent, except that an international application filed under the treaty defined in section
> 351(a) shall have the effects for purposes of this subsection of an application filed in the United States
> only if the international application designated the United States and was published under Article 21(2)
> of such treaty in the English language.

5.   **Claims 27-38, 44-46, 48-52 are rejected under 35 U.S.C. 102(e)** as being

anticipated by Adya et al. (US 6,266,658 B1), hereinafter "Adya".

As per claim 27, Adya teaches a system for evaluating a plurality of candidate

index sets for a workload in a database system (See abstract) comprising:

- "a workload evaluator which evaluates each statement within the workload using

  collected database statistics" at Col. 6 line 55 to Col. 7 line 10;

(Adya teaches the module 230 that parses each individual query

in the workload to identify candidate indexes by utilizing index

usage information [collected database statistics] provided by

database server 225.)

- "an index solution evaluation which, responsive to the workload evaluator,

  evaluates each index in a candidate index set with respect to the workload, the

  candidate index solution being one of the plurality of candidate index set, each

  candidate index set derived from an index superset formed by the union of a

  current index set and a proposed index set" at Col. 8 lines 1-20 and Col. 9 lines

  1-20;

(Adya teaches the list of potential indexes comprises "all

existing indexes" and "propose indexes". The cost of each

indexed is evaluated to eliminated indexes exceeds a

predetermined fraction of the total workload cost.)

- "a solution/rollup evaluator which, responsive to the index solution evaluator,

  evaluates the candidate index solution" at Col. 10 lines 35-55 and Fig. 7, 716;

(Adya teaches the step of evaluate the resulting configuration
R' to eliminate unused indexes form R' to produce configuration
R'')

- "a solution refiner which, responsive to the solution/rollup evaluator, generates at

  least one new candidate index solution" at Col. 11 lines 13-30 and Fig. 7, 717;

(Adya teaches the step of pruning of indexes in R'' to eliminate

indexes with low benefit to generate a new index solution (i.e.,

configuration F))

As per claim 28, Adya teaches the system of claim 27 as discussed above.

Adya also teaches: "the solution refiner generates at least one new candidate index

solution by eliminating at least one index within the candidate index solution that does

not adhere to user-imposed constraints" at Col. 11 lines 13-30.

(Adya teaches the step of pruning of indexes in R'' to eliminate

indexes with low benefit to generate a new index solution (i.e.,

configuration F.))

As per claim 29, Adya teaches the system of claim 28 as discussed above.

Adya also teaches: "the constraint is a user-defined constraint" at Col. 9 lines 10-15 and

Col. 11 lines 15-25.

As per claim 30, Adya teaches the system of claim 28 as discussed above.

Adya also teaches: "the constraints is a memory usage constraint" at Col. 10 lines 33-

35.

As per claim 31, Adya teaches the system of claim 27 as discussed above. Adya also teaches: "the solution refiner generates at least one new candidate index solution by eliminating at least one index on a small table under evaluation, and wherein the at least one index does not enforce an integrity constraint" at Col. 2 lines 55-65.

As per claim 32, Adya teaches the system of claim 27 as discussed above. Adya also teaches: "the workload evaluator evaluates an execution plan created by an optimizer, the execution plan comprising, for each statement of the workload, an execution plan which represents a series of steps for executing the statement, the workload evaluator further generating and recording statistics based on the evaluation of the execution plan" at Col. 6 line 55 to Col. 7 line 10.

As per claim 33, Adya teaches the system of claim 32 as discussed above. Adya also teaches: "each execution plan is created based on available access paths" at Col. 2 lines 30-40.

As per claim 34, Adya teaches the system of claim 32 as discussed above. Adya also teaches: "each execution plan is created based on statistics for at least one schema object accessed by the statement" at Col. 7 lines 1-10 and Col. 1 lines 40-65.

As per claim 35, Adya teaches the system of claim 34 as discussed above. Adya also teaches: "the at least one schema object is a table" at Col. 1 lines 40-65.

As per claim 36, Adya teaches the sytem of claim 34 as discussed above. Adya also teaches: "the at least one schema object is an index" at Col. 1 lines 40-65.

As per claim 37, Adya teaches the system of claim 32 as discussed above. Adya also teaches: "the workload evaluator, for a table accessed by a statement under

evaluation, identifies at least one index which would be used to retrieve data from the table upon an execution of the statement" at Col. 6 lines 55-65.

As per claim 38, Adya teaches the system of claim 32 as discussed above. Adya also teaches: "the workload evaluator determined a cost of the execution plan" at Col. 7 lines 12-13.

As per claim 44, Adya teaches the system of claim 32 as discussed above. Adya also teaches: "the statistics include an index usage" at Col. 7 lines 5-10.

As per claim 45, Adya teaches the system of claim 32 as discussed above. Adya also teaches: "the statistics include a cost of the execution plan" at Col. 7 lines 10-15.

As per claim 46, Adya teaches the system of claim 27 as discussed above. Adya also teaches: "the statements are SQL statements" at Col. 8 lines 10-15.

As per claim 48, Adya teaches the system of claim 27 as discussed above. Adya also teaches: "the solution refiner is responsive to a predetermined maximum number of allowed indexes" at Col. 10 lines 17-18.

As per claim 49, Adya teaches the system of claim 27 as discussed above. Adya also teaches: "the solution refiner is responsive to available storage space" at Col. 10 lines 10-15.

As per claim 50, Adya teaches the system of claim 27 as discussed above. Adya also teaches: "the proposed index set is provided by a user" at Col. 2 lines 40-45.

As per claim 51, Adya teaches the system of claim 27 as discussed above.

Adya also teaches: "the proposed index set is provided by an expert system" at Col. 2

lines 60-62.

As per claim 52, Adya teaches the system of claim 27 as discussed above.

Adya also teaches: "an execution plan is created without creating indexes which are not

in the current index set" at Col. 11 lines 1-12.

Claim Rejections - 35 USC § 103

6.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

7.   **Claims 1-6, 8-12, 16, 18, 20, 22-24, 26, 53-54, 56, 58-60, 62-64, 66-70, 74, 76-**

77, 79-81, 83-86, 88-90, 92-96, 100, 102-103, 105-107, 109-113, 115-117, 119-123,

127, 129-130, 132-134, 136 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Chaudhuri et al. (US 5,960,423A), hereinafter "Chaudhuri (I)",

and in view of Chaudhuri et al (US 6,223,171), hereinafter "Chaudhuri (II)".

As per claims 1,53, 54, 110, Chaudhuri (I) teaches a method and system for

evaluating a plurality of candidate index set for a workload of database statements in a

database system (See abstract) comprising:

- "forming an index superset from a union of a current index set and a proposed

  index set" at col.7 lines 56-63 and Fig. 3, elements 232, 233, 234.

(Chaudhuri (I) teaches the storage of what-if indexes [proposed

indexes that are absent from the database server] and existing

indexes [current index set]. The storage of the indexes serves as

an index superset).

- "deriving a candidate index set from the index superset, the derived candidate

  index set being included in the plurality of candidate index sets" at col. 7 line 64

  to col. 8 line 10.

(Chaudhuri (I) teaches that the superset of proposed index sets

and existing index sets are considered in evaluating index

configurations [candidate index sets]).

- "analyzing collected database statistics based on the derived candidate index

  set" at Col. 5 line 64 to Col. 6 line 2, Col. 9 lines 3-11, and Col. 10 lines 13-25.

(Chaudhuri (I) teaches that the statistics information included

in the database schema are collected from database server 220 on

startup. Statistical information for "what-if index" are

generated by reading all n pages of the database tables". The

costs [generated statistics] for each candidate index

configuration are determined and stored.)

Chaudhuri (I) does not teach a user interface that presents the collected

statistics. However, Chaudhuri (II) teaches a similar method includes the step of

presents the statistics to users at Fig. 6-8 and Fig. 10-15. It would have been obvious to

one ordinarily skilled in the art at the time of the invention to present these statistics to

the administrator or user because of the advantages of allowing the user to analyze the

data. By presenting the statistics, the user can gain a better understanding of the costs

and the advantages of particular indexes with each workload. Through the analysis, the

user can determine the potential impact and improvements in performance of a

candidate index set on a particular workload as taught at Chaudhuri (II) col. 1 line 64 to

col. 2 line 13.

Claims 53-54 refers to "repeatedly derives a candidate index set" which can be

found at Chaudhuri (I) col. 8 lines 46-56.

As per claims 2, 58, 84, and 111, Chaudhuri (I) and Chaudhuri (II) teach the method,

computer program and system of claims 1, 53, 54, 110 as discussed above. Chaudhuri (II)

also teaches: "deriving current index statistics for the workload responsive to the current

index set, the presented generated statistics comprising the generated current index

statistics" at Col. 10 lines 13-21 and Fig. 15.

As per claims 3, 59, 85, and 112, Chaudhuri (I) and Chaudhuri (II) teach the method,

computer program and system of claims 1, 53, 54, 110 as discussed above. Chaudhuri (II)

also teaches: "repeatedly deriving a candidate index set and analyzing collected statistics

based on the proposed index set" at col. 23 lines 48-67.

As per claims 4, 60, 86, and 113, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 3, 59, 85, 112 as discussed above.

Chaudhuri (II) also teaches: " terminating the repeated execution when at least one

candidate index solution is found that adheres to user-imposed constraints and no further

indexes can be removed from said candidate index solution without degrading

performance of the workload and without degrading disabling an integrity constraint" at

Col. 15 lines 35-64 and Col. 23 line 25 to Col. 24 line 6.

As per claims 6, 64, 90, and 117, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 1, 53, 54, 110 as discussed above.

Chaudhuri (I) also teaches: "wherein analyzing statistics for a statement comprises

generating at least one statistic based on an execution plan created by an optimizer" at

col. 10 lines 53-56 and col. 8 lines 4-7.

As per claims 8, 66, 92, and 119, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 6, 64, 90, and 117 as discussed

above. Chaudhuri (I) also teaches: "wherein the execution plan is based on statistics for

at least one schema object accessed by the statement" at col. 10 lines 53-56 and col. 5

lines. 52-56. (The query optimizer may user an index over any single

table of the database. The costs include the index configuration

of both the indexes and the tables. The statistics are based

upon the schema objects).

As per claims 9, 67, 93, and 120, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 8, 66, 92, and 119 as discussed

above. Chaudhuri (I) also teaches: "the at least one schema object is a table" at col. 12

lines 20-29.

As per claims 10, 68, 94, and 121, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 8, 66, 92, and 119 as discussed above. Chaudhuri (I) also teaches: "the atleast one schema object is an index" at col. 10 lines 54-55.

As per claims 11, 69, 95, and 122, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 6, 64, 90, and 117 as discussed above. Chaudhuri (I) also teaches: "for a table accessed by a statement under evaluation, using the execution plan to identify at least one index that would be used to retrieve data from the table upon an execution of the statement" at col. 6 lines 9-13 and col. 10 lines 53-56. (The execution plan is returned with a cost estimate of executing a designated query for the designated candidate index configuration. The index selection tool attempts to select an index configuration that is optimal, so the cost will lead to the identification of an index).

As per claims 12, 70, 96, and 123, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 6, 64, 90, and 117 as discussed above. Chaudhuri (I) also teaches: "the optimizer generates a cost of the execution plan" at col. 10 lines 48-56. (The query optimizer returns an execution plan with a cost estimate. Because the optimizer returns both the execution plan and the cost estimate, the optimizer is considered to have generated both the plan and the cost).

As per claims 16, 74, 100, and 127, Chaudhuri (I), Chaudhuri (II) teach the

method, computer program and system of claims 6, 64, 90, 117 as discussed above.

Chaudhuri (II) also teaches: "the collected database statistics comprise the number of

executions of the statement" at Figs. 6-7.

As per claims 18, 76, 102, and 129, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 6, 64, 90, and 117 as discussed

above. Chaudhuri (II) also teaches: "the collected database statistics comprise an index

usage" at Fig. 8.

As per claims 20, 77, 103, and 130, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 1, 53, 54, and 110 as discussed

above. Chaudhuri (I) also teaches: "wherein the statements are SQL statements" at col.

5 lines 40-41 and col. 5 lines 61-64.

As per claims 22, 79, 105, and 132, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 1, 53, 54, and 110 as discussed

above. Chaudhuri (I) also teaches: "deriving a candidate index set is responsive to a

predetermined maximum number of allowed indexes" at col. 13 lines 1-9.

As per claims 23, 80, 106, and 133, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 1, 53, 54, and 110 as discussed

above. Chaudhuri (II) also teaches: "wherein deriving a candidate index set is

responsive to available storage space" at col. 1 lines 24-34.

As per claims 24, 81, 107, and 134, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 1, 53, 54, and 110 as discussed

above. Chaudhuri (II) also teaches: "the proposed index set is provided by a user" at col. 12 lines 1-10.

As per claims 26, 83, 109, and 136, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 1, 53, 54, and 110 as discussed above. Chaudhuri (I) also teaches: "an execution plan is created without creating indexes which are not in the current index set" at col. 7 lines 52-63.

As per claims 56, 62, 88, and 115, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 1, 53, 54, and 110 as discussed above. Chaudhuri (I) also teaches: "generating baseline statistics for each statement in the workload, wherein generating statistics is additionally based on the baseline statistics" at col. 6 lines 14-22 and col. 10 lines 48-56.

(Chaudhuri (1) teaches that the query optimizer estimates a cost for each query [statement] in the workload. The estimates for each query are then summed to determine statistics of the workload with the candidate index set).

As per claims 5, 63, 89, and 116, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 56, 62, 88 and 115 as discussed above. Chaudhuri (I) also teaches: "analyzing the collected baseline statistics comprises disabling current indexes" at Col. 14 lines 60-65.

8.   **Claims 7, 65, 91, and 118 are rejected under 35 U.S.C. 103(a) as being**

unpatentable over Chaudhuri (I) and Chaudhuri (II) as applied to claims above,

and further in view of Jakobsson et al. (US 5,924,088 A), hereinafter "Jakobsson".

        As per claims 7, 65, 91, and 118, Chaudhuri (I) and Chaudhuri (II) teach the

method, computer program and system of claims 6, 64, 90, and 117 as discussed

above. Chaudhuri (I) also teaches that an execution plan is created at col. 10 lines

53-56. Chaudhuri (I) also teaches that the indexes are used in order to access the

database at col. 3 lines 50-54. Chaudhuri I and II do not explicitly teach that the

"execution plan is based on available access paths". However, Jakobsson teaches a

similar method for index selection includes the use of access paths at col. 4 lines 1-4. It

would have been obvious to one ordinarily skilled in the art at the time of the invention

to base the execution plan on an access path because the performance characteristics

for a data retrieval may vary greatly depending on the choice of index access path as

taught at col. 4 lines 8-12. The costs of the statements of the workload can be

calculated through the use of the access paths. Using these paths would allow for

improved calculations of the costs of each statement.

9.   **Claims 13-15, 71-73, 97-99, and 124-126 are rejected under 35 U.S.C. 103(a)**

as being unpatentable over Chaudhuri (I) and Chaudhuri (II) as applied to claims above,

and further in view of Eberhard et al. (US 6,003,022), hereinafter "Eberhard".

As per claims 13, 71, 97, and 124, Chaudhuri (I) and Chaudhuri (II) teach the method, computer program and system of claims 12, 38, 70, 98, and 123 as discussed above. Chaudhuri (I) describes an invention that selects an index that would work best for a workload as described above. Chaudhuri (I) also teaches that each query does have a particular cost associated with each particular index at col. 10 lines 14 9. Chaudhuri (I) and Chaudhuri (II) do not explicitly teach that the cost of the execution plan is derived from a resource as claimed. However, Eberhard does teach that the execution costs are derived from a resource at col. 3 lines 43-45. It would have been obvious to on ordinarily skilled in the art at the time of the invention to derive the cost of the execution plan from a particular resource because of execution costs in both CPU and I/O as taught at col. 3 lines 43-59. By calculating the costs of the queries under a particular index, the invention would be capable, of calculating how each candidate index can affect each statement in the workload. Deriving the cost of the execution plan from a resource use needed to execute the statement allows the system to know how each query will affect the system's performance. Considering the system's performance will allow a better cost to be derived for the indexing system.

As per claims 14, 72, 98, and 125, Chaudhuri (I), Chaudhuri (II), and Eberhard teaches the method, computer program and system of claims 13, 71, 97, 124 as discussed above. Eberhard also teaches: "the resource use includes CPU execution time" at col. 3 lines 43-44.

As per claims 15, 73, 99, and 126, Chaudhuri (I), Chaudhuri (II), and Eberhard teaches the method, computer program and system of claims 13, 71, 97, 124 as

discussed above. Eberhard also teaches: "the resource use includes input/output

access" at col. 3 lines 43-44.

10.   **Claims 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable**

over Adya as applied to claims 27-38, 44-46, 48-52 above, and further in view of

Eberhard.

As per claim 39, Adya teaches the system of claim 38 as discussed above.

Adya does not explicitly teach that "the cost of the execution plan is derived from a

resource" as claimed. However, Eberhard does teach that the execution costs are

derived from a resource at col. 3 lines 43-45. It would have been obvious to on

ordinarily skilled in the art at the time of the invention to derive the cost of the execution

plan from a particular resource because of execution costs in both CPU and I/O as

taught at col. 3 lines 43-59. By calculating the costs of the queries under a particular

index, the invention would be capable, of calculating how each candidate index can

affect each statement in the workload. Deriving the cost of the execution plan from a

resource use needed to execute the statement allows the system to know how each

query will affect the system's performance. Considering the system's performance will

allow a better cost to be derived for the indexing system.

As per claim 40, Adya and Eberhard teach the system of claim 39 as discussed

above. Eberhard also teaches: "the resource use includes CPU execution time" at col. 3

lines 43-44.

As per claim 41, Adya and Eberhard teach the system of claim 39 as discussed

above. Eberhard also teaches: "the resource use includes input/output access" at col. 3

lines 43-44.

11.   **Claims 17, 75, 101 and 128 are rejected under 35 U.S.C. 103(a)** as being

unpatentable over Chaudhuri (I) and Chaudhuri (II) as applied to claims above, and

further in view of Smith et al. (US 5,404,510 A), hereinafter "Smith".

As per claims 17, 75, 101, and 128, Chaudhuri (1) and Chaudhuri (II) teach the

method, computer program and system include a query optimizer which searches for

the best index to evaluate a given workload. Both Chaudhuri (I) and (II) do not explicitly

teach that "the collected database statistics comprise a user-defined importance of the

statement". Smith does teach a user-defined importance of the statement at col. 7 lines

22-32. It would have been obvious to one ordinarily skilled in the art at the time of the

invention to allow a user to define the importance of the statements found in the

workload because the index selection tool could evaluate the statistics of the indexes

according -to the importance of the statements. A user could rank the importance of the

queries in the workload. The ranking could then be used to define an index that works

best for the workload. The index would then be created in consideration of the higher

ranked statements.

12.   **Claims 43 is rejected under 35 U.S.C. 103(a)** as being unpatentable over Adya

as applied to claims 27-39, 45-46 and 48-52 above, and further in view of Smith et al.

(US 5,404,510 A), hereinafter "Smith".

As per claims 43, Adya teaches the system of claim 32 discussed above. Adya

does not explicitly teach "the statistics include a user-defined important of the

statement. Smith does teach a user-defined importance of the statement at col. 7 lines

22-32. It would have been obvious to one ordinarily skilled in the art at the time of the

invention to allow a user to define the importance of the statements found in the

workload because the index selection tool could evaluate the statistics of the indexes

according -to the importance of the statements. A user could rank the importance of the

queries in the workload. The ranking could then be used to define an index that works

best for the workload. The index would then be created in consideration of the higher

ranked statements.

13.   **Claims 21, 78, 104, and 131 are rejected under 35 U.S.C. 103(a)** as being

unpatentable over Chaudhuri (I) and Chaudhuri (II) as applied to claims 20, 77, 103 and

130 above, and further in view of Celis et al. (US 6,021,405), hereinafter "Celis".

As per claims 21, 78, 104, and 131, Chaudhuri (I) teaches the use of

statistics to find the cost of statements using a particular index. Both Chaudhuri I and II

do not teach that the workload is reduced into unique statements in order to determine

these costs. Celis teaches that the workload is reduced into unique expressions at col. 5

lines 37-44. Chaudhuri (I) teaches that the index selection tool is expensive and that

each request to run query optimizer increases the cost of time and memory at col. 6 lines 23-35. Furthermore, Chaudhuri (I) teaches that the queries of a workload are sent to the query optimizer at col. 10 lines 13-60. Chaudhuri (I) also teaches that the cost evaluation tool attempts to reduce the number of invocations of query optimizer by determining costs of queries of workloads without invoking query optimizer at col. 10 lines 61-67. By not sending particular queries to the query optimizer, the workload is reduced. In particular, Chaudhiuri (I) teaches the elimination of running repetitions of the query on atomic indexes. By not running repetitions of a query on similar indexes, Chaudhuri (I) is reducing the workload into unique statements. Celis teaches in greater depth that redundant expressions are removed from the queries in order to save cost as taught at col. 1 lines 38-51.

It would have been obvious to one ordinarily skilled in the art at the time of the invention to generate the statistic using only unique expressions because of the ability to reduce processing time for redundant queries as taught at Celis col. 1 lines 41-51. Celis's invention is a query optimizer that is used to reduce the cost of each statement as taught at col. 1 lines 26-31. By only optimizing the unique statements, the optimizer will not be burdened by redundant statements. Chaudhuri (I) teaches the reduction of the number of invocations of query optimizer at col. 6 lines 51-59. By reducing the workload into unique statements, Chaudhuri (I) will invoke query optimizer fewer times for statements that had previously been optimized. The needless optimizations cost more processing time and ultimately increase the execution time for the query as taught at Cells col. 1 lines 42-51 and Chaudhuri I col. 6 lines 51-59.

14.   **Claim 47 is rejected under 35 U.S.C. 103(a)** as being unpatentable over Adya

as applied to claims 27-39, 45-46, 48-52 above, and in view of Cellis.

As per claim 47, Adya teaches the system of claim 27 discussed above. Adya

does not explicitly teach that "the workload is reduced into unique statements". Celis

teaches that the workload is reduced into unique expressions at col. 5 lines 37-44. Celis

teaches in greater depth that redundant expressions are removed from the queries in

order to save cost as taught at col. 1 lines 38-51. It would have been obvious to one

ordinarily skilled in the art at the time of the invention to generate the statistic using only

unique expressions because of the ability to reduce processing time for redundant

queries as taught at Celis col. 1 lines 41-51. Celis's invention is a query optimizer that is

used to reduce the cost of each statement as taught at col. 1 lines 26-31. By only

optimizing the unique statements, the optimizer will not be burdened by redundant

statements. By reducing the workload into unique statements, Adya will invoke query

optimizer fewer times for statements that had previously been optimized. The needless

optimizations cost more processing time and ultimately increase the execution time for

the query as taught at Celis col. 1 lines 42-51.

15.   **Claims 25, 82, 108, 135 are rejected under 35 U.S.C. 103(a) as being**

unpatentable over Chaudhuri (I) and Chaudhuri (II) as applied to claim 1 above,

and further in view of Adya.

As per claims 25, 82, 108, and 135, Chaudhuri (I) and Chaudhuri (II) teaches the method, computer program and system as discussed in claims 1, 53, 54, 110 above. Both Chaudhuri (I) and Chaudhuri (II) do not specifically teach an expert system that chooses the index configuration. However, using an expert system to propose index set is well known in the art, as exemplary by Adya at Col. 2 lines 60-63. Thus, It would have been obvious to one ordinarily skilled in the art at the time of the invention to use an expert system because of the ability of expert systems to make index selections. By using an expert system, the administrator would not have to determine the most useful index set. The expert system could use prior knowledge and the calculations found in Chaudhuri (I) to determine an index set.

16.   **Claims 55, 61, 87 and 114 rejected under 35 U.S.C. 103(a) as being unpatentable over Chaudhuri (I) and Chaudhuri (II) as applied to claims 1, 53, 54, 110 above, and further in view of Gurry et al. ("Oracle Performance Tuning"), hereinafter "Gurry".**

As per claims 55, 61, 87, and 114, Chaudhuri (I) teaches the estimation of queries over candidate index sets as taught at col. 10 lines 48-56. Chaudhuri (I) and Chaudhuri (II) do not teach that the index volatility is included in the statistics. Gurry does teach the index volatility in the statistics at pages 353-354. Gurry teaches the volatility of indexes through the HEIGHT and DEL LF ROWS columns found in the statistics. If the statistics for the HEIGHT or DEL LF ROWS exceed a particular number, the index is a candidate

for dropping and recreating. The dropping and recreating of an index is a part of the

volatility of the index. It would have been obvious to one ordinarily skilled in the art at the time

of the invention to include the index volatility in the statistics because of the costs

incurred by dropping and recreating indexes. The index volatility demonstrates to the

user the possibility of the index to be dropped and recreated. The volatile indexes may

need to be rebuilt in order to obtain optimal performance [pg. 354]. Indexes over volatile

tables may also become a space management problem [pg. 354]. The volatility statistics

allow a DBA to be aware of the problems that may arise over particular index selections.

17.   Claim 57 is rejected under 35 U.S.C. 103(a) as being unpatentable over

Adya as applied to claims above, and further in view of Gurry.

As per claim 57, Adya teaches the system of claim 32 discussed above. Adya

does not teach that the index volatility is included in the statistics. Gurry does teach the

index volatility in the statistics at pages 353-354. Gurry teaches the volatility of indexes

through the HEIGHT and DEL LF ROWS columns found in the statistics. If the statistics

for the HEIGHT or DEL LF ROWS exceed a particular number, the index is a candidate

for dropping and recreating. The dropping and recreating of an index is a part of the

volatility of the index. It would have been obvious to one ordinarily skilled in the art at the time

of the invention to include the index volatility in the statistics because of the costs

incurred by dropping and recreating indexes. The index volatility demonstrates to the

user the possibility of the index to be dropped and recreated. The volatile indexes may

need to be rebuilt in order to obtain optimal performance [pg. 354]. Indexes over volatile

tables may also become a space management problem [pg. 354]. The volatility statistics

allow a DBA to be aware of the problems that may arise over particular index selections.

18.   Claims 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over

Adya as applied to claims 27-38, 44-46, and 48-52 above, and in view of

Finkelstein et al. ("Physical Database Design for relational Database), hereinafter

"Finkelstein".

As per claim 42, Adya teaches the system of claim 32 as discussed above.

Adya does not explicitly teach that "the statistics include the number of execution of the

statement. However, Finkelstein teaches a similar system for index selection utilizing

collected statistics from database, wherein the statistics include "the number of

execution of the statement" at page 99. Thus, it would have been obvious to one of

ordinary skill in the art at the time of the invention was made to modify Adya's teaching

to include "the number of execution of the statement" in the statistics so that the

workload could be calculated faster and more precisely because the same statement

executed multiple times could be grouped and calculated at once.

Response to Arguments

19.   Applicant's arguments filed March 24, 2004 have been fully considered but they

are not persuasive. The examiner respectfully traverses applicant's arguments.

Regarding claim 1, applicant argued at pages 20-21 that Chaudhuri (I) and (II)

"does not analyze collected statistics, because the indexes of Chaudhuri are "what-if"

indexes and, as such, have no associated collected statistics". On the contrary,

Chaudhuri (I) teaches: "what-if index creation tool 236 **creates a what-**

if index by reading all n pages of the designated table t and

generating the statistical information for the what-if index

based on all n pages similarly as for step 412 and 414.

Gathering statistical information for what-if index entries 234

in this manner may result in relatively more accurate cost

estimates by query optimizer 240 at the expense of increasing

time and memory costs in reading all n pages of the table t" at Col.

9 lines 35-40. Therefore, Chaudhuri (I) actually creates the indexes for "what-if" indexes

and the statistical information are gathered and stored in the database.

Applicant states that Chaudhuri (I) starts with the set of all possible indexes and

then attempts to reduce the number of indexes. The examiner disagrees with the applicant

in Chaudhuri (I)'s formation of an index superset. At col. 7 lines 46-63, Chaudhuri (I)

teaches a superset of indexes that consist of what-if (proposed) index entries and

existing index entries. Chaudhuri (I) discusses gathering statistics for each proposed

index and the existing index. Furthermore, Chaudhuri (I) teaches the creation of a

superset by storing each index in a similar manner [the difference is that the proposed

indexes are marked]. The superset created by Chaudhuri (I) consists of sets of both

proposed [what-if] indexes and existing indexes.

The applicant states that Chaudhuri (I) starts with all possible indexes and then reduces the number of indexes and therefore index configuration for evaluation at col. 6 lines 62-67. By starting with all possible indexes, Chaudhuri (I) teaches a superset of all possible indexes, indexes that have existed and new ones that are proposed. Chaudhuri (I) does not teach that all of the indexes are evaluated. The candidate index selection tool determines a set of candidate indexes for evaluation as taught at col. 6 lines 62-67.

Applicant's argument regarding claim 27 has been consider but are moot in view of the new ground of the rejection. The Adya reference teaches the index superset comprises "all existing indexes" and "proposed indexes" at Col. 8, lines 1-20. Adya also teaches that the statistics are collected from the database server at Col. 7 lines 1-10.

Applicant's arguments regarding claims 47, 51, 33, 39-41, 43, 57 have been considered but are moot in view of new grounds of rejection.

Regarding claims 6 and 32, the applicant argues that the references do not teach or suggest that the cost evaluation tool looks at and evaluates the [execution] plan itself. The amended claim does not state that the execution plan is evaluated. At col. 10 lines 53-57, Chaudhuri (I) does teach that the query optimizer returns an execution plan that comprises the cost estimate, an evaluation of the execution plan.

Regarding claims 21, 78, 104, and 131, applicant states that it would not be obvious to one ordinarily skilled in the art at the time of the invention to combine the Celis reference with Chaudhuri I and Chaudhuri II.

The examiner disagrees with the lack of motivation for combining the three references. Chaudhuri I teaches the optimization of queries associated with the cost evaluation as shown at Fig. 3 References 240, 241, 322, and 324. Celis better describes the optimization of queries as shown in the title.

Applicant states that Celis does not teach that the workload is reduced into unique statements. The examiner disagrees with the applicant's argument. Chaudhuri I teaches that the index selection tool is expensive and that each request to run query optimizer increases the cost of time and memory at col. 6 lines 23-35. Furthermore, Chaudhuri (I) teaches that the queries of a workload are sent to the query optimizer at col. 10 lines 13-60. Chaudhuri (I) also teaches that the cost evaluation tool attempts to reduce the number of invocations of query optimizer by determining costs of queries of workloads without invoking query optimizer at col. 10 lines 61-67. By not sending particular queries to the query optimizer, the workload is reduced. In particular, Chaudhuri (I) teaches the elimination of running repetitions of the query on atomic indexes. By not running repetitions of a query on similar indexes, Chaudhuri (I) is reducing the workload into unique statements. Celis teaches in greater depth that redundant expressions are removed from the queries in order to save cost as taught at col. 1 lines 38-51.

Applicant's arguments with respect to claims 25, 51, 82, and 135 have been considered but are moot in view of the new ground of rejection. The Adya reference teaches that using expert system for index selection is well known in the art at page 55-65. Thus, it would have been obvious to one of ordinary skill in the art to combine

Chauhuri (I) and Chaudhuri (II) with Adya because of the ability of expert systems to

make index selections. By using an expert system, the administrator would not have to

determine the most useful index set. The expert system could use prior knowledge and

the calculations found in Chaudhuri (I) to determine an index set.

Regarding claims 7, 65, 91, and 118, applicant argued at page 24 that "both

Chaudhuri I and Chaudhuri II are directed to reducing costs in selecting index sets by

simulating, but not actually creating the index. Thus, one skilled in the art would not be

motivated to combine the index access method of Jakobsson with the simulated

indexes because there would be no access paths for the nonexistence indexes of

Chaudhuri I and Chaudhuri II". On the contrary, Chaudhuri actually creates the index for

"what-if" index at Col. 9 lines 33-40, reproduced below:

"For another embodiment, what-if index creation tool 236 creates a what-if index

by reading all n pages of the designated table t and generating the statistical information

for the what-if index based on all n pages ..."

Applicant's arguments with respect to claims 31 has been considered but are

moot in view of new ground of rejection. Adya teaches "eliminating at least one index on

a small table" at Col. 2 lines 55-60 and Col. 9 lines 1-20.

Regarding claims 13-16, 71-74, 97-100, 124-127, applicant argued that one skill

in the art would not motivate to combine Eberhard with Chaudhuri (I) and Chaudhuri (II).

On the contrary, Eberhard teaches the tool for estimate costs of an application program

accessing a database (See abstract). In Chaudhuri (I) and Chaudhuri (II), the cost of

execution plan is also cost of an application program accessing a database. Therefore,

it would have been obvious to one of ordinary skill in art to combine Eberhard with

Chaudhuri (I) and (II) because these references direct the method of calculating cost of

accessing a database.

Regarding claims 17, 75, 101, and 128, applicant argued that it would not be

obvious to combine index-selection mechanism of Smith with simulate "what-if" indexes

of Chaudhuri (I) and Chaudhuri (II). The examiner respectfully disagrees because Smith

and Chaudhuri (I), (II) direct to methods for solving index selection problem. Thus, it

would have been obvious to one of ordinary skill in the art to combine these references.

Regarding claims 55, 57, 61, 87, and 114, applicant argued that it would not have

been obvious to one skilled in the art to combine the volatility statistics of Gury with the

simulated indexes of Chaudhuri I and Chaudhuri II because no volatility statistics exist

for the "what-if" indexes of Chaudhuri I and II. On the contrary, as discussed above,

Chaudhuri I actually created the what-if indexes and stored in the database.

Chaudhuri's "what-if" indexes are therefore also have the volatility attributes. Thus, it

would have been obvious to one of ordinary skilled in the art at the time of the invention

was made to combine these references.

Conclusion

20.   The prior art made of record, listed on form PTO-892, and not relied upon, if any,

is considered pertinent to applicant's disclosure.

If a reference indicated as being mailed on PTO-FORM 892 has not been

enclosed in this action, please contact Lisa Craney whose telephone number is **(703)**

305-9601 for faster service.

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Khanh B. Pham whose telephone number is (703) 308-

7299. The examiner can normally be reached on Monday through Friday 7:30am to

4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, John E Breene can be reached on (703) 305-9790. The fax phone number

for the organization where this application or proceeding is assigned is 703-872-9306.

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Khanh B. Pham
Examiner
Art Unit 2177

KBP
Jun 11, 2004

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PRIMARY EXAMINER